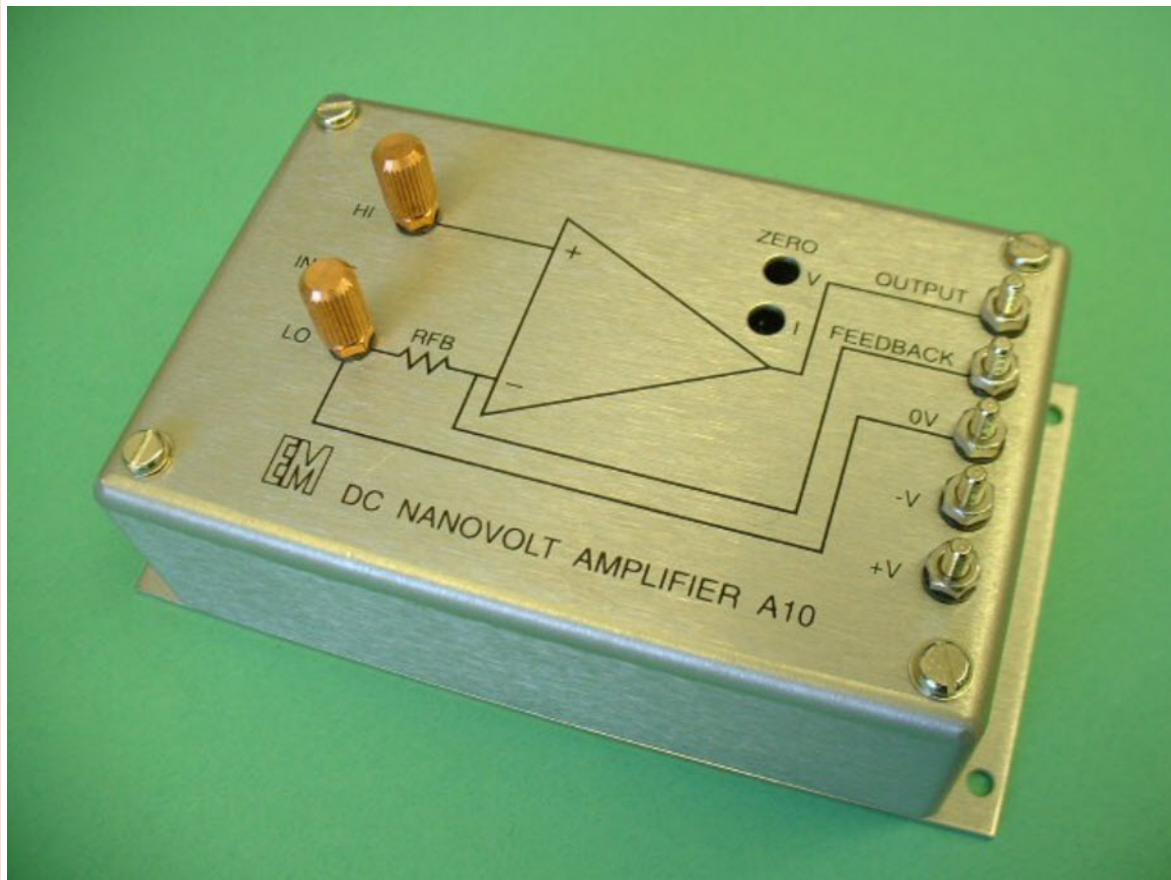




ELECTRONICS



DC NANO VOLT AMPLIFIER MODEL A10

The EM A10 is a low level amplifier module for sensitive measurements, data collection and systems, where signals below 1 nanovolt may be measured. It is ideal for the input unit for precision voltage measuring systems, requiring voltage sensitivity for measuring low noise and low impedance sources. The noise level of the A10 is equivalent to a perfect resistor of 20 ohms. When used with a digital voltmeter, steady one nanovolt digits may be displayed, with a response time constant of less than a second. The input voltage stability of the A10 is very high, with the drift around a nanovolt per degree C. The input connectors are made from pure copper. The input impedance is very high, and is time dependent, determined by the internal loop gain of the amplifier. The very high DC gain of greater than five million million means that high overall gain may be used, controlled precisely by feedback resistors, thus ensuring a good degree of linearity with the accuracy defined by the feedback resistors used. Despite the gain, the A10 is stable with 100% feedback. This allows a filter capacitor to be used across the feedback resistor to control the rise time and noise from the measurement circuit. The loop gain is reduced from the DC figure of five million million at the rate of 30 dB per frequency decade to unity at 20 KHz. This determines the response time of the amplifier, which will vary according to the set gain. The A10 can deliver 2 milli-amps of current from its output and so the set gain will determine the level of output signal at low values of gain less than 1,500. The internal 'low' feedback resistor is 1 ohm, and so if a gain of unity is set by connecting the output to the feedback terminal directly, the maximum output voltage will be 2 millivolts. The internal feedback resistor needs to be this low, because the noise generated by this resistor is in series with the input noise, and any higher resistance would cause a significant increase in the total A10 noise. The power consumption is very low, making the A10 suitable for battery powered applications. The minimum supply voltage is plus and minus 5.5 volts and the quiescent current consumption is 1.5 milli-amps. Care is required over the choice of power supply, if batteries are not to be used, to ensure that the very low noise of the A10 is not degraded by series mode or common mode noise being allowed to interfere with small signals. The A10 has very high rejection of common mode noise, but at nanovolt levels great care must be taken. The A10 is small enough to mount on a p.c. board if required, and the case is made of heavy gauge Mumetal to give an extra degree of magnetic and electrostatic screening. The voltage and current offset controls are accessible with a small insulated trimming tool through the two holes in the front. Care must be taken with these adjustments.

ULTRA LOW LEVEL DC MEASUREMENTS

SPECIFICATION

DC NANOVOLT AMPLIFIER MODEL A10

Noise

Equivalent noise resistance is typically 20 ohms. Noise voltage depends on bandwidth, e.g. rise time constant 1 second gives a peak to peak noise voltage of 1 nanovolt. There is no 1/f component.

Offset Voltage

Adjustable to zero. T.C. 1nV per deg C slow change or 5nV per deg C differential.

Offset Current

Adjustable to zero. T.C. typically 5pA per deg C

Gain and Bandwidth

Greater than 5×10^{13} at DC reducing to unity at 20KHz. Amplifier gain is set using an external feedback resistor.

The fixed internal feedback component is 1 ohm +/- 1% 5 ppm, so for a gain of 10,000, the feedback element must be 9999 ohms.

Input Resistance

Greater than 1 Gohm, with gain set to 1 million or less, subject to time following an input step function.

Source Resistance

The A10 closely follows the source Johnson noise characteristic from source resistance of 20 ohms up to about 5K ohms. With source resistances below 20 ohms the noise is substantially constant down to zero ohms.

Input Level

The A10 will operate with input voltages up to +/- 2mV.

Output Level

The A10 will provide an output up to +/- 3V D.C. at 2mA load, including the current taken by the feedback resistor.

Connectors

The input connectors are 3mm studs and nuts in pure copper. All other connectors are M3 brass studs and nuts.

Power Supply

Minimum +/- 5.5V at 1.5mA quiescent. Maximum +/- 12V. Nominal supply +/- 6V

Dimensions and Weight

Length 120mm. Width 70mm. Height 35mm. + 6mm for terminals. Weight 490gm.

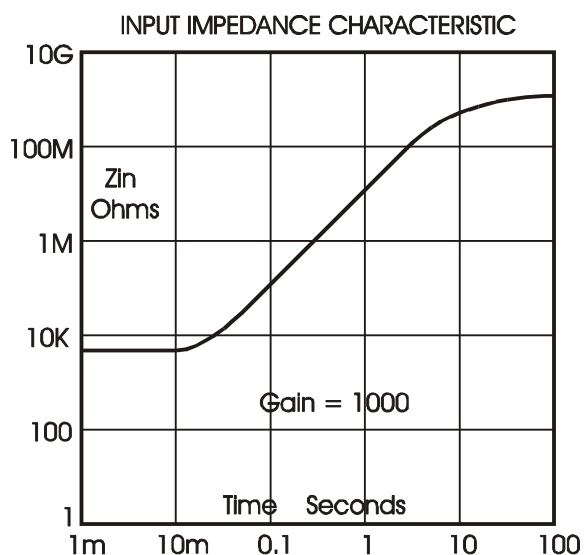
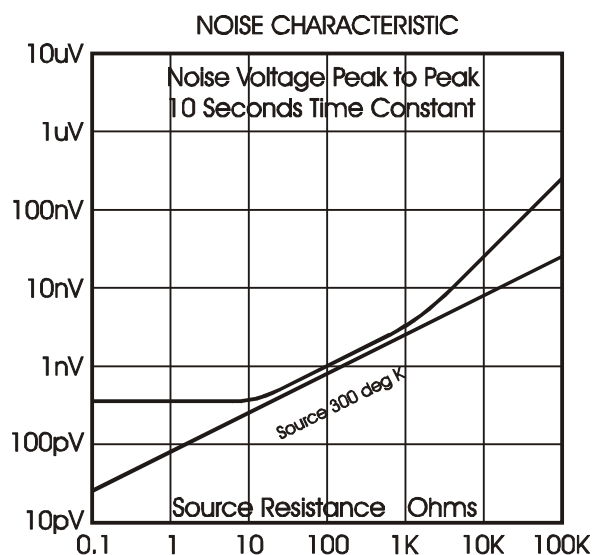
Fixing

4 Holes required 3mm diameter. 114mm X 54mm.

Note: Feedback Components

There is an internal feedback resistor from the 'Feedback' terminal to the input 'Lo' of 1 ohm +/- 1% 5 ppm/degree C. The gain is set by connecting an external resistor from 'Output' to 'Feedback'. The value of this resistor is $R_{fb} = (\text{gain required} - 1) \text{ ohms}$. i.e. Gain = 10,000, $R_{fb} = 9999 \text{ ohms}$. As the internal feedback resistor has a tolerance of 1%, the external feedback resistor needs to be adjusted by +/- 1%. The gain stability will be 5ppm per degree C plus the stability of the applied feedback resistor.

There is a 10pF capacitor connected from 'Output' to 'Feedback'



This Data Sheet is dated 2/11/2006 and is subject to change without prior notification